Source, cyclotron & meson decay at rest
Technology: Working Group

Conveners: Mike Shaevitz, Jelena Marcic, Phil Barbeau

13:30 - 17:40 Technology: Source, cyclotron & meson decay at rest

Location: Physics Building (Room 3-191, Connection Info)

Material: Bullet and Discussion Points

13:30 **OscSNS and pion DAR** *10'*
Speaker: David Dean (Oak Ridge Nat. Lab)

13:45 **Introduction to the SOX Program** *10'*
Speaker: Gioacchino Ranucci (INFN Milan)
Material: Slides

13:55 **Ce Source experiment** *15'*
Speaker: Jelena Maricic (Univ. of Hawaii)
Material: Slides

14:10 **Cr source experiment** *15'*
Speaker: Prof. Jonathan Link (Virginia Tech)
Material: Slides

14:25 **IsoDAR and nu-e scattering** *30'*
Speaker: Matthew Toups (MIT)
Material: Slides

14:55 **Discussion** *30'*

15:25 **coffee break** *20'*

15:45 **Pion and Kaon DAR Experiments** *35'*
Speaker: Joshua Spitz (MIT)
Material: Slides

16:20 **Discussion** *15'*

16:35 **Coherent scattering** *25'*
Speaker: Rex Tayloe (Indiana University)
Material: Slides

17:00 **discussion** *15'*

17:15 **Xsec Measurements with DAR beams** *15'*
Speaker: Jong Hee Yoo (Fermilab)
Material: Slides

17:30 **Discussion** *10'*

- Radioactive source experiments could be a cost effective way to investigate electron antineutrino disappearance in the region of the reactor anomaly.

- The SOX program will use high-intensity radioactive sources of neutrinos or antineutrinos to investigate disappearance oscillations. The initial data run would use sources placed below the BOREXINO detector.
  - This phase is expected to have physics results within 5 years (cerium run will be finished by the end of 2017, followed by a chromium run that should be finished by mid 2018).
  - The physics results are expected to probe at 95% C.L. the entire Reactor Antineutrino Anomaly region (3-sigma). This phase will also provide important R&D for future upgrades relevant to SOX and the US 51Cr program on LZ, SNO+, Ricochet and possibly others.
  - The cost of this initial phase would have an initial cost in the $2M-$3M range and fit into the proposed FOA category.
  - The future upgrades could include higher intensity sources and deployment of the sources within the detector to get enhanced oscillation parameter space coverage.

- The IsoDAR experiment will make a highly definitive investigation of electron antineutrino disappearance in the reactor anomaly region and make precision electroweak measurements searching for neutrino non-standard interactions.
  - The experiment uses a very high intensity 8Li antineutrino source placed near a large scintillator detector such as KamLAND or JUNO. IsoDAR can also be coupled with WATCHMAN and provide an important component of the WATCHMAN physics program.
  - The cost of ISODAR is estimated to be $30M so it is a mid-scale project. At this point, the development of the IsoDAR cyclotron and neutrino source needs engineering R&D support at about the $1M level to complete prototypes and prepare a Conceptual Design Report to be submitted to the agencies.

- OscSNS has the capability to make a definitive search for electron antineutrino appearance using a pion DAR beam with very much lower uncertainties than LSND.
  - The cost is at the \$12M scale for civil construction and \$8M for a new 800 ton liquid scintillator detector with a start date 3 years after initiation.
  - With the high neutrino rate at SNS, the experiment can cover the full LSND signal region in 2 years with some capability to see oscillatory behavior for $\Delta m^2 > 1\ eV^2$.
  - The successful support by DOE NP for infrastructure development at the SNS related to the fundamental physics neutron beamline and support facility can serve as a model for future infrastructure development related to OscSNS and other neutrino efforts supported by DOE HEP.

- JPARC-P56 will directly probe the LSND anomaly with nuebar appearance using a 2x25 ton liquid scintillator detectors at the JPARC-MLF 1 MW 3 GeV spallation neutron facility.
  - First data is expected in the next 2-3 years. The experiment will provide competitive, but not definitive, sensitivity to the LSND allowed region.
  - The project is of modest scale with Japanese costs at the $5M level, but has the potential for upgrades and additional detector modules. The main US contribution to JPARC-P56 will be the dilute Gd-loaded liquid scintillator, which will fit well into the FOA scope with an estimated cost of $1.5M.

- The JPARC-MLF beam also uniquely allows the possibility to study kaon decay-at-rest (KDAR) muon neutrinos for the first time, and the related physics with an expected sample of over 10^5 muon neutrino charged current events.
  - The KDAR muon neutrinos are monoenergetic with an energy of 236 MeV. As the only relevant known-energy muon neutrino above the charged current threshold, this unique neutrino can be used for studying short baseline oscillations indicative of a sterile flavor, neutrino cross sections relevant for future CP violation searches, and nuclear physics with a known-energy, weak-interaction-only probe.

- Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) is an unambiguous prediction of the Standard Model. Recent advances in detector design now put this so-far elusive prize within reach.
  - Such a measurement will open the door to a host of new ways to better understand neutrino properties, and to search for new physics.
  - CEvNS represents an eventually dominant background for dark matter detection, and its measurement will demonstrate dark matter detector response.
  - As a neutral current process, it will be a new tool for sterile neutrino oscillation experiments.

- The COHERENT experiment will search for CEvNS at the SNS with three detector targets (CsI, Xe, Ge).
  - The 1.4 MW SNS will have a neutrino flux of 3.3 x10^7 neutrinos cm^{-2} s^{-1} at 20 m with a clean pion DAR spectrum. A neutron measurement campaign has identified several deployment sites within 30 m of the source with low neutron backgrounds.
  - Phase 1 of the experiment is likely to produce initial results within the year, and would have a cost of $2-3M, fitting well into the proposed FOA category.

- The CENNS experiment will search for CEvNS at the BNB with a deployment of a 500 kg-scale LAr detector.
  - The 32 kW BNB will have a neutrino flux of 5 x10^5 neutrinos cm^{-2} s^{-1} at 20 m, and a neutron measurement campaign has indicated that this source of background is manageable with sufficient shielding in a green field site.
  - The first results are expected after 2018, and are coupled to the availability of existing detectors.
  - The possibility of deploying the CENNS-10 detector to the SNS, in collaboration with COHERENT, is being explored in the shorter term.
  - The expected cost is $2 M, which fits well into the proposed FOA category.

- DAR neutrino sources can be used to measure a number of important neutrino interaction cross sections.
  - Neutrino-nucleus cross-section measurements on various targets are inputs to supernova modeling and for understanding supernova detectors. Specifically, the CENNS, CAPTAIN-BNB, JPARC-MLF, and COHERENT (Ge, CsI, Xe) at SNS experiments will address many of these cross-section measurements. Interesting targets include Ar, Pb, Fe and O.
  - To make these measurements one needs to understand the flux spectrum, the detector characteristics and the backgrounds. Neutron backgrounds are the most important and need to be addressed by location or shielding.